The Avalon Explosion By Astrobio - Jan 8, 2008

<http://www.astrobio.net/topic/origins/origin-and-evolution-of-life/the-avalon-explosion/>

At the beginning of the Paleozoic era, multicellular animals underwent an ‘explosion’ in diversity known as the ‘Cambrian explosion’. This artist’s rendering, based on fossil evidence, of some of the bizarre life forms, now extinct, that emerged during this time.

Scientists have known for some time that most major groups of complex animals appeared in the fossils record during the Cambrian Explosion, a seemingly rapid evolutionary event that occurred 542 million years ago. Now Virginia Tech paleontologists, using rigorous analytical methods, have identified another explosive evolutionary event that occurred about 33 million years earlier among macroscopic life forms unrelated to the Cambrian animals. They dubbed this earlier event the "Avalon Explosion."

The discovery, reported in the January 4 issue of Science, suggests that more than one explosive evolutionary event may have taken place during the early evolution of animals. The finding is helping astrobiologists understand how life has evolved on Earth alongside the planet’s changing environment.

The Cambrian explosion event refers to the sudden appearance of most animal groups in a geologically short time period between 542 and 520 million years ago, in the early Cambrian Period. Although there were not as many animal species as in modern oceans, most (if not all) living animal groups were represented in the Cambrian oceans. "The explosive evolutionary pattern was a concern to Charles Darwin, because he expected that evolution happens at a slow and constant pace," said Shuhai Xiao, associate professor of geobiology at Virginia Tech. "Darwin’s perception could be represented by an inverted cone with ever expanding morphological range, but the fossil record of the Cambrian Explosion and since is better represented by a cylinder with a morphological radiation at the base and morphological constraint afterwards."

Researchers studied fossils of the Ediacara in order to understand how major branches of life evolved. Ediacara are the oldest complex, multicellular organisms known and lived in the Earth’s oceans before the Cambrian Explosion.

Credit: Virginia Tech

**Darwin reckoned that there should be long and hidden periods of animal evolution before the Cambrian Explosion,** Xiao said.

But paleontologists have not found such evidence, and recently scientists have learned that biological evolution has not been moving on a smooth road. "Accelerated rates may characterize the early evolution of many groups of organisms," said Michal Kowalewski, professor of geobiology at Virginia Tech.

To test whether other major branches of life also evolved in an abrupt and explosive manner, Virginia Tech graduate students Bing Shen and Lin Dong, along with Xiao and Kowalewski, analyzed the Ediacara fossils: the oldest complex, multicellular organisms that had lived in oceans from 575 to 542 million years ago; that is, before the Cambrian Explosion of animals. "These Ediacara organisms do not have an ancestor – descendant relationship with the Cambrian animals, and most of them went extinct before the Cambrian Explosion," said Shen. "And this group of organisms – most species – seems to be distinct from the Cambrian animals."

But how did those Ediacara organisms first evolve, Shen asked. Did they also appear in an explosive evolutionary event, or is the Cambrian Explosion a truly unparalleled event?

"We identified 50 characters and mapped the distribution of these characters in more than 200 Ediacara species. These species cover three evolutionary stages of the entire Ediacara history across 33 million years," said Shen.

The three successive evolutionary stages are represented by the **Avalon, White Sea, and Nama assemblages** (all named after localities where representative fossils of each stage can be found). The earliest Avalon stage was represented by relatively few species.

These Ediacaran-age fossils from Mistaken Point, Newfoundland, Canada, are among the oldest ever found of complex life forms.

Credit: G.M. Narbonne, Queen’s University, 2000

Surprisingly, however, as shown by Shen and colleagues, these earliest Ediacara life forms already occupied a full morphological range of body plans that would ever be realized through the entire history of Ediacara organisms. "In other words, major types of Ediacara organisms appeared at the dawn of their history, during the Avalon Explosion," Dong said. "Subsequently, Ediacara organisms diversified in White Sea time and then declined in Nama time. But, despite this notable waxing and waning in the number of species, the morphological range of the Avalon organisms were never exceeded through the subsequent history of Ediacara."

Kowalewski said their research team had not anticipated the discovery. "Using the scientific literature, we were trying to create a more rigorous reconstruction of the morphological history of Ediacara organisms," he said.

The process involved adapting quantitative methods that had been used previously for studying morphological evolution of animals, but never applied to the enigmatic Ediacara organisms. "We think of diversity in terms of individual species. But species may be very similar in their overall body plan. For example, 50 species of fly may not differ much from one another in terms of their overall shape – they all represent the same body plan. On the other hand, a set of just three species that include a fly, a frog and an earthworm represent much more morphological variation. We can thus think of biodiversity not only in terms of how many different species there are but also how many fundamentally distinct body plans are being represented. Our approach combined both those approaches," said Kowalewski.

**Explosions of diversity in the evolution of life were of concern to Charles Darwin, who expected evolution to happen at a constant pace over long periods of time.**

Credit: John Collier (portrait) and James Stanfield (photo)

"In addition, the method relies on converting different morphologies into numerical (binary) data. This strategy allows us to describe, more objectively and more consistently, enigmatic fossil life forms, which are preserved mostly as two-dimensional impressions and are not understood well in terms of function, ecology, or physiology," Kowalewski said.

Scientists are still unsure what were the driving forces behind the rapid morphological expansion during the Avalon explosion, and why the morphological range did not expand, shrink, or shift during the subsequent White Sea and Nama stages.

**"But, one thing seems certain — the evolution of earliest macroscopic and complex life also went through an explosive event before to the Cambrian Explosion," Xiao said. "It now appears that at the dawn of the macroscopic life, between 575 and 520 million years ago, there was not one, but at least two major episodes of abrupt morphological expansion."**

The article, "The Avalon Explosion: Evolution of Ediacara Morphospace," by Shen, Dong, Xiao, and Kowalewski, appears in the Jan. 4 issue of Science. Shen and Dong have graduated. Dong is at British Petroleum and Shen at Rice University, both in Houston.

Learn more about Xiao’s work and Kowalewski’s work.

Related Web Sites

The Cambrian’s Many Forms

The Cambrian Explosion: Tooth and Claw

Attack of the Giant Insects

Our Earliest Animal Ancestors

Tracking Back Animal Evolution

Phosphate Does a Body Good?

- See more at: <http://www.astrobio.net/topic/origins/origin-and-evolution-of-life/the-avalon-explosion/#sthash.tva9SdiF.dpuf>

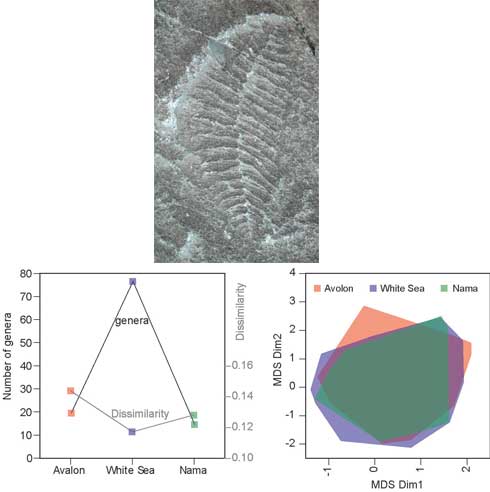
<http://www.vtnews.vt.edu/articles/2008/01/2008-1.html>

## Paleontologists say two explosive evolutionary events shaped early history of multicellular life

(Image details are provided at end of story.)

[More Sharing ServicesShare](http://addthis.com/bookmark.php?v=250&pub=vtnews)

[Printer-Friendly PDF](http://www.vtnews.vt.edu/global_assets/php/widgets/print-to-pdf/printme.php?url=aHR0cDovL3d3dy52dG5ld3MudnQuZWR1L2FydGljbGVzLzIwMDgvMDEvMjAwOC0xLmh0bWw=&ct=vtArticle&type=print)

BLACKSBURG, Va., Jan. 4, 2008 – Scientists have known for some time that most major groups of complex animals appeared in the fossils record during the Cambrian Explosion, a seemingly rapid evolutionary event that occurred 542 million years ago. Now Virginia Tech paleontologists, using rigorous analytical methods, have identified another explosive evolutionary event that occurred about 33 million years earlier among macroscopic life forms unrelated to the Cambrian animals.

They dubbed this earlier event the "Avalon Explosion."

The discovery, reported in the Jan. 4 issue of Science, suggests that more than one explosive evolutionary event may have taken place during the early evolution of animals.

The Cambrian explosion event refers to the sudden appearance of most animal groups in a geologically short time period between 542 and 520 million years ago, in the early Cambrian Period. Although there were not as many animal species as in modern oceans, most (if not all) living animal groups were represented in the Cambrian oceans.

"The explosive evolutionary pattern was a concern to Charles Darwin, because he expected that evolution happens at a slow and constant pace," said Shuhai Xiao, associate professor of geobiology at Virginia Tech. “Darwin’s perception could be represented by an inverted cone with ever expanding morphological range, but the fossil record of the Cambrian Explosion and since is better represented by a cylinder with a morphological radiation at the base and morphological constraint afterwards.”

Darwin reckoned that there should be long and hidden periods of animal evolution before the Cambrian Explosion, Xiao said.

But paleontologists have not found such evidence, and recently scientists have learned that biological evolution has not been moving on a smooth road. “Accelerated rates may characterize the early evolution of many groups of organisms,” said Michal Kowalewski, professor of geobiology at Virginia Tech.

To test whether other major branches of life also evolved in an abrupt and explosive manner, Virginia Tech graduate students Bing Shen and Lin Dong, along with Xiao and Kowalewski, analyzed the Ediacara fossils: the oldest complex, multicellular organisms that had lived in oceans from 575 to 542 million years ago; that is, before the Cambrian Explosion of animals.

"These Ediacara organisms do not have an ancestor-descendant relationship with the Cambrian animals, and most of them went extinct before the Cambrian Explosion," said Shen. “And this group of organisms – most species – seems to be distinct from the Cambrian animals.”

But how did those Ediacara organisms first evolve, Shen asked. Did they also appear in an explosive evolutionary event, or is the Cambrian Explosion a truly unparalleled event?

“We identified 50 characters and mapped the distribution of these characters in more than 200 Ediacara species. These species cover three evolutionary stages of the entire Ediacara history across 33 million years,” said Shen.

The three successive evolutionary stages are represented by the Avalon, White Sea, and Nama assemblages (all named after localities where representative fossils of each stage can be found). The earliest Avalon stage was represented by relatively few species.

Surprisingly, however, as shown by Shen and colleagues, these earliest Ediacara life forms already occupied a full morphological range of body plans that would ever be realized through the entire history of Ediacara organisms. "In other words, major types of Ediacara organisms appeared at the dawn of their history, during the Avalon Explosion," Dong said. "Subsequently, Ediacara organisms diversified in White Sea time and then declined in Nama time. But, despite this notable waxing and waning in the number of species, the morphological range of the Avalon organisms were never exceeded through the subsequent history of Ediacara."

Kowalewski said their research team had not anticipated the discovery. “Using the scientific literature, we were trying to create a more rigorous reconstruction of the morphological history of Ediacara organisms,” he said.

The process involved adapting quantitative methods that had been used previously for studying morphological evolution of animals, but never applied to the enigmatic Ediacara organisms. “We think of diversity in terms of individual species. But species may be very similar in their overall body plan. For example, 50 species of fly may not differ much from one another in terms of their overall shape – they all represent the same body plan. On the other hand, a set of just three species that include a fly, a frog and an earthworm represent much more morphological variation. We can thus think of biodiversity not only in terms of how many different species there are but also how many fundamentally distinct body plans are being represented. Our approach combined both those approaches,” said Kowalewski.

“In addition, the method relies on converting different morphologies into numerical (binary) data. This strategy allows us to describe, more objectively and more consistently, enigmatic fossil life forms, which are preserved mostly as two-dimensional impressions and are not understood well in terms of function, ecology, or physiology,” Kowalewski said.

Scientists are still unsure what were the driving forces behind the rapid morphological expansion during the Avalon explosion, and why the morphological range did not expand, shrink, or shift during the subsequent White Sea and Nama stages.

"But, one thing seems certain -- the evolution of earliest macroscopic and complex life also went through an explosive event before to the Cambrian Explosion,” Xiao said. “It now appears that at the dawn of the macroscopic life, between 575 and 520 million years ago, there was not one, but at least two major episodes of abrupt morphological expansion."

The article, “The Avalon Explosion: Evolution of Ediacara Morphospace," by Shen, Dong, Xiao, and Kowalewski, appears in the Jan. 4 issue of Science. Shen and Dong have graduated. Dong is at British Petroleum and Shen at Rice University, both in Houston.

Learn more about [Xiao’s work](http://www.paleo.geos.vt.edu/Shuhai) and [Kowalewski's work](http://www.geos.vt.edu/people/michalk/) online.

The research was supported by the National Science Foundation Sedimentary Geology and Paleobiology program.

PHOTO CAPTION (Fossil/Fractofuss image- top): The Ediacara fossil Fractofusus misrai from the ~565 million year old Mistaken Point Formation in Newfoundland, Canada, represents the earliest Ediacara assemblage, known as the Avalon assemblage.

PHOTO CAPTION (Diversity vs. Morphospace/graph image- bottom): Scientists have recognized three Ediacara assemblages that lived between 575 and 542 million years ago. These are in geochronological order, the Avalon, White Sea, and Nama assemblages, all of which preceded the Cambrian explosion of animals. The left panel shows that number of genera (black line) and how they are dissimilar from each other (gray line) in the three Ediacara assemblages. The right panel shows morphospace occupation of the three Ediacara assemblages. Although there are fewer genera in Avalon than latter assemblages, Avalon fossils occupy the full range of Ediacara morphospace, indicating an explosive evolutionary pattern (the Avalon explosion) similar to the Cambrian explosion of animals that occurred about 542 million years ago.

<http://creation.com/ediacaran-explosion>

# Ediacaran ‘explosion’

## Another thumping headache for evolutionists

***by***[***Shaun Doyle***](http://creation.com/shaun-doyle)

Photo wikipedi

Dickinsonia costata

##### Dickinsonia Costata**Published: 5 March 2008(GMT+10)**

One of the most famous features of the fossil record that evolutionists have a hard time explaining is the ‘Cambrian explosion’. Most extant basic animal bodyplans simply appear in the fossil record in the Lower Cambrian rocks with next to no antecedent evidence of their existence in the rocks.[1](http://creation.com/ediacaran-explosion" \l "endRef1) Therefore, the major bodyplans of animals all had to evolve very quickly, which is stretching the bounds of plausibility. However, paleontologists have recently identified another ‘explosion’ in the fossil record in the Ediacaran ‘period’, which they dubbed the ‘Avalon Explosion’ (‘dated’ 635–542 Ma ago).[2](http://creation.com/ediacaran-explosion" \l "endRef2)

The Ediacaran biota is a group of fossils of multicellular organisms that are found directly below the Cambrian (‘dated’ 542–488 Ma), and they consist of a wide range of morphologies. However, both their origin and relationship to Cambrian animals is a complete mystery to evolutionists. They are typically divided up into three major fossil assemblages: the Avalon (575–565 Ma), White Sea (560–550 Ma) and Nama (550–542 Ma) assemblages.[3](http://creation.com/ediacaran-explosion" \l "endRef3) All these assemblages display an incredibly wide array of morphology, and there is no trace of them in the fossil record above the Ediacaran period.

Shen et al. point out that though there is a wide variety of morphology in the Ediacaran biota, all the different fossil assemblages have a similar range of morphology. Since they believe these different assemblages represent different time periods within the Ediacaran period, they believe that there is little evolution shown in the Ediacaran fossils. As Shen et al. report:

‘A comprehensive quantitative analysis of these fossils indicates that the oldest Ediacara assemblage—the Avalon assemblage (575 to 565 Ma)—already encompassed the full range of Ediacara morphospace.’[4](http://creation.com/ediacaran-explosion" \l "endRef4)

*the major bodyplans of animals all had to evolve very quickly, which is stretching the bounds of plausibility*

Therefore, they conclude that the rise of the Ediacara mirrors the Cambrian explosion, with all its attendant problems for evolution. So now evolutionists have got not one but two ‘big bangs in biology’[5](http://creation.com/ediacaran-explosion" \l "endRef5)to deal with within 50 million years of each other!

**The Cambrian and Ediacaran explosions present a massive problem for evolution because each records a wide variety of morphologies that come onto the scene practically immediately according to the fossils, with no identifiable ancestors. Darwinian evolution, on the other hand, would expect such widely disparate body plans to emerge only after a long geological history.****[6](http://creation.com/ediacaran-explosion" \l "endRef6) No known or accepted mechanism can account for such rapid evolution.**

**What’s worse is that the Cambrian and Ediacaran explosions bear no relationship at all to one another. Therefore, this sort of ‘evolutionary explosion’ had to happen twice. Once stretches credulity to breaking point—twice blows it out of the water completely.**

The sudden appearance of this diverse assemblage of Ediacaran biota, of course, provides no problem for a creationist understanding of the fossils. They are simply another grouping of organisms that were overwhelmed and fossilized by the Flood.[7](http://creation.com/ediacaran-explosion" \l "endRef7),[8](http://creation.com/ediacaran-explosion" \l "endRef8)

### Related Articles

* [Exploding evolution](http://www.creation.com/article/930)
* [‘Evolutionary origins’ continue to be pushed back in time](http://creation.com/images/pdfs/tj/j18_3/j18_3_7.pdf)
* [Is the evolutionary tree changing into a creationist orchard?](http://www.creation.com/article/5067)
* [Earliest multicellular life?](http://creation.com/earliest-multicellular-life)
* [Giant compound eyes, half a billion years ago?](http://creation.com/compound-eye-fossils)
* [Cosmos by Neil deGrasse Tyson](http://creation.com/cosmos-neil-degrasse-tyson-episode-2)
* [The Cambrian explosion in colorful, zoological context](http://creation.com/cambrian-explosion-and-animal-biodiversity)

### Further Reading

* [Fossils Questions and Answers](http://creation.com/fossils-questions-and-answers)

### References

1. Marshall, C.R., Explaining the Cambrian ‘explosion’ of animals, Annual Review of Earth and Planetary Sciences**34**:355–384, 2006. [Return to text](http://creation.com/ediacaran-explosion#txtRef1).
2. Shen, B., Dong, L., Xiao, S. and Kowalewski, M., The Avalon explosion: evolution of Ediacara morphospace, Science**319**:81–84, 2008. [Return to text](http://creation.com/ediacaran-explosion#txtRef2).
3. Waggoner, B., [The Ediacaran biotas in space and time](http://www.creation.com/redirect.php?http://icb.oxfordjournals.org/cgi/content/full/43/1/104), Integrative and Comparative Biology,**43**:104–113, 2003. [Return to text](http://creation.com/ediacaran-explosion#txtRef3).
4. Shen et al., ref. 2, p. 81. ‘Morphospace’ is a spatial representation of the morphological range in a given classification of organisms. [Return to text](http://creation.com/ediacaran-explosion#txtRef4).
5. Berardelli, P., [Another big bang for biology](http://www.creation.com/redirect.php?http://sciencenow.sciencemag.org/cgi/content/full/sciencenow;2008/103/1), ScienceNOW Daily News, 3 January 2008. [Return to text](http://creation.com/ediacaran-explosion#txtRef5).
6. Wells, J., Icons of Evolution, Regnery Publishing, Washington, DC, pp. 41–42, 2000. [Return to text](http://creation.com/ediacaran-explosion#txtRef6).
7. Wieland, C., [Holy Grail or another evolutionary tale?](http://www.creation.com/article/4409) Creation**27**(3):20–22, 2005. [Return to text](http://creation.com/ediacaran-explosion#txtRef7).
8. Froede Jr, C.R., Precambrian metazoans within a young-earth Flood framework, Journal of Creation**13**(2):90–95, 1999. [Return to text](http://creation.com/ediacaran-explosion#txtRef8).